TEXTILE BASED ON AN ABRASION-RESISTANT MIXTURE OF COTTON AND TECHNICAL FIBERS

Background of the invention

The present invention relates to a textile based on an abrasion-resistant mixture of cellulose fibers, for example cotton fibers, and technical fibers.

More particularly, the subject matter of the invention is a fabric with the appearance of jeans or more generally having the appearance of cotton cloth which is intended for the manufacture of pants, jackets, including bomber jackets, gloves, and the like.

Description of the prior art

Fabrics having qualities during abrasive impacts, for example the impacts experienced by the clothing of a motorcyclist when he falls off, are known in the prior art. These fabrics generally require a minimum of two separate layers: either a comfort lining is positioned, to make it possible to wear next to the skin, or a coating of products with a low coefficient of friction (silicone, polytetrafluoroethylene (PTFE), and the like) is produced on a resistant material (mesh or fabric made of aramids, and the like); this is the case of work gloves intended for protecting against abrasive impacts. However, the latter solution exhibits two major disadvantages: the discomfort due to the lack of breathability of the complex because of the coating and the "industrial" appearance given by the coating. In addition, these are fabrics which allow only slight aeration in summer and thus they are rather unpleasant to wear during this season.

The great majority of the other alternatives known in the prior art are polyamides which melt at a temperature of less than 250°C. Moreover, the latter

are not self-extinguishing, which represents an obvious additional danger for the wearer of clothing produced with such textiles. This is because, during an abrasive impact, for example on a motorbike, such materials can rapidly locally reach their melting point and are then in direct contact with the skin of the user, then bringing about lesions and burns which are difficult to treat (the risk of complications is increased in the event of fire).

Polyesters have a degree of resistance to abrasion but do not have satisfactory fire-resistant qualities. Polyethylene has very good mechanical qualities but its melting point lies in the vicinity of 120°C. Only para- and meta-aramids have mechanical and fire-resistant qualities but their performances deteriorate in the presence of UV radiation. Ceramics might combine these qualities but their cost is still too high to allow economically viable industrial operation.

In any case, none of these materials has satisfactory textile qualities; they are difficult to dye and have an unpleasant feel for the wearer of the clothing, which corresponds to the feeling of contact of plastic with the skin.

Thus, in the world of equipment for the motorcyclist in general and with regard to pants in particular, only overpants, pants made of multilayer fabric or pants made of leather can be taken advantage of in providing protection from abrasion. Respective disadvantages exist in each of these cases, in particular in summer (discomfort, lack of breathability and of hydrophilicity, poor appearance, and the like).

Finally, United States patent US 4 920 000 discloses a monolayer fabric comprising two yarns, a natural "comfort" yarn and a "technical" yarn possessing good properties of resistance to abrasion and to

temperature, these two yarns being woven in a weave defining at least two separate portions in the thickness of the fabric, a first outer portion predominantly of technical yarn and a second inner portion predominantly of comfort yarn, said portions being at least partially entangled. The technical yarn used in the invention disclosed in this patent is an intimate mixture of different natural and artificial materials, each having a specific technical role, the periphery of the yarn being of the same composition as the center of the yarn. The technical yarn thus obtained is only very partially covered at the surface and the part of this yarn made of synthetic material is highly exposed, which does not make it possible to overcome the disadvantages of the textiles based on artificial yarns described above, in particular with regard to the visual appearance and the comfort. In addition, such a technical yarn does not make it possible to color the fabric obtained as either the colorants are very poorly retained by the synthetic materials used for the technical fibers or use is made of polyester and polyamide, which dye well but for which the feel and the gloss present problems with regard to the look of the fabric obtained and with regard to the technical performances, which are poorer.

Summary of the invention

Thus, the main aim of the present invention is to provide a fabric which makes it possible to reduce the difference in performances between technical textiles and textiles intended for clothing. More specifically, the aim of the invention is to provide a fabric which makes it possible to solve the technical problems of the fabrics known in the prior art and thus has excellent mechanical properties, in particular of resistance to fire, to high temperatures and to abrasion, which makes possible a hold of the colorants which are applied thereto at a level at least equal to

that possessed by fabrics made of natural material, for example cellulose (cotton or flax in particular), and which are as comfortable to wear as these fabrics.

The aim of the invention is achieved with a monolayer fabric comprising two yarns, a "comfort" yarn made of cellulose material and a technical yarn possessing good properties of resistance to abrasion and to temperature, these two yarns being woven or knitted so as to define at least two separate portions in the thickness of the fabric, a first outer portion predominantly of technical yarn and a second inner portion predominantly of comfort yarn, said portions being at least partially entangled.

The invention is more particularly wherein the technical yarn is a yarn produced from continuous and preferably nontextured filaments, the core of the technical yarn being covered over at least 75%, preferably at least 85%, of its surface by a coating at least partially comprising natural fibers.

This fabric has excellent mechanical qualities and textile qualities (in terms of ease of weaving, on the one hand, and of comfort, on the other hand) and it is intended in particular for motorcyclists or users of skateboards, roller skates, bicycles or snowboards, providing them with protection, comfort and a stylish appearance.

Due to its monolayer design, it is intended for the manufacture of light clothing which can be worn next to the skin and which offers excellent protection from abrasion in the event of falls. Protection is provided by the extreme resistance to abrasion of the technical yarn, which is present predominantly in the outer portion of the fabric.

It should be noted here that the term "abrasion-resistant material" is understood to mean a material having a hardness and a coefficient of friction such that they allow it to be virtually equivalent, during tests of resistance to abrasion under actual conditions, to competition-grade leathers approved by the Fédération Française de Motocyclisme [French Motorcycling Federation], according to Standard No. prEN 13595-2.

Thus, tests performed on various samples of textiles have shown the results described below. The method used is not exactly the standardized method but it approaches it in the stages involved and in its reproducibility.

Samples with an area of 80 mm by 50 mm, placed under a weighted support of approximately 10 kg which is brought into direct contact with a dry road surface with a moderate size grading, were tested at 37°C. The weighted support is moved translationally until all the warp yarns had been completely torn. The measurements given below represent the distances covered by each sample before complete destruction of the warp yarns:

- fabric of France (standard according to Standard EN388 of 1993 from the IFTH, under the reference LEM 6), 100% cotton: 25 m
- jeans of new "Levis 501™" type, 100% cotton: 12 m
- jeans of old "Levis 501™" type, 100% cotton: 2.5 m
- jeans comprising warp and weft yarns reinforced with polyester and Kevlar™, as an intimate mixture: 15 m
- competition-grade leather: 62.5 m
- textile according to the invention, composed of a weft made of cotton and of a warp of twisted cotton/aramid filaments: 29.5 m
- textile according to the invention as described in the example below, composed of a weft made of cotton and of a warp of continuous aramid filaments covered with blue cotton: 45 m

- textile according to the invention, composed of a weft made of cotton and of a warp of cotton-covered polyethylene filaments: 65 m.

It is thus noted that the textiles obtained according to the invention, although they make it possible to retain the external appearance of a 100% cotton fabric, demonstrate much better performances than those of the 100% cotton fabrics of jeans type and, in some cases, performances virtually identical to those obtained with leathers used competitively by the Fédération Française de Motocyclisme.

The comfort arises from a special construction of "warp effect" type; the warp effect can be obtained by the counts of the yarns employed (for example, thicker in warp than in weft) or else by the weave itself (satins, twills, half plaits, and the like), making it possible to combine the above qualities with a single layer of fabric which protects by virtue of its outer surface and is worn next to the skin by virtue of its hydrophilic inner surface. This fabric also has high-level thermal qualities.

Description of the preferred embodiments

According to a first preferred embodiment of the invention, the fabric is obtained by weaving, the weft yarn constituting the comfort yarn and the warp yarn constituting the technical yarn.

In this case, the weave used is of warp effect type but having floats of less than or equal to 4 yarns, preferably a 3/1 twill (float of 3) or 2/1 twill (float of 2).

This is because, within the base weaves, the following are found: twill, satin and cloth. In the present case, it is the cloth which is the least suitable.

Satin offers significant possibilities, just like twill, due to the possibility of correctly proportioning warp yarns at the outer surface of the fabric (the desired result being the warp effect).

Twill, in its 3/1 or 2/1 version, is the base weave for denim; it is therefore the ideal weave with regard to the appearance of the fabric for a jeans imitation. Nevertheless, any weave can be envisaged provided that the combination of the latter and of the yarn counts promote the presence of the warp yarns at the outer surface and promote the presence of the weft yarns inside. The fabric can be weft stretch or unchanging.

In addition, in other cases than for 3/1 or 2/1 twill weaves, it is necessary to correctly control, in addition to the proportions of the outer/inner portions of the fabric, the number and the size of the floats. This is because some weaves make possible a high possible presence of the warp yarns outside the fabric (or "front") but at the expense of very large floats. The risk then is that a yarn will be caught on an outside element and will be pulled by the latter, thus deforming the structure of the fabric. This characteristic is referred to as the nonslipping. Therefore, a float of less than or equal to 4 yarns is regarded as acceptable.

According to a second embodiment of the invention, the fabric is obtained by knitting. This is because knitting can provide as good a support as weaving provided that it is possible to differentiate the "front" yarns (technical yarns) from the "back" yarns (comfort yarns), the important thing being not to have too much (35% of the visible surface of the fabric at most) technical yarn at the back of the mesh due to its high cost in comparison with the back yarn. Generally, these knitted fabrics will be produced on double-needle-bed machines. However, the molleton mesh which

is produced on a single-needle-bed machine will easily meet the conditions of performance and of cost (acceptable front yarn/back yarn proportions). In the case of the mesh, the elasticity of the fabric is natural, due to the structure given by the knitting (no yarn is under tension).

Advantageously, the comfort yarn is a yarn of cellulose material combined with an elastic yarn to give a "stretch yarn" yarn. This is because, in the case of an abrasive impact, the fabric begins first by deforming by virtue of the elasticity of the elastic weft, which makes it possible to absorb a portion of the energy received by the fabric during the impact, and then the remainder of the energy given off by the rubbing of the fabric along the road is absorbed by the warp technical yarn, which then itself has to have satisfactory properties of resistance to abrasion (in other words, a sufficiently high compressive strength and a sufficiently low coefficient of friction) in order not to decompose.

In addition, the core of the abrasion-resistant technical yarn is advantageously made of a material having a melting point of greater than 250°C, preferably of greater than 400°C. It is also possible to envisage the use of materials having an extremely high melting point, such as meta- and para-aramid. During an abrasive impact resulting in an increase in their temperature, these materials first lose their mechanical characteristics and then decompose without melting. It is also possible to envisage the use of a core which can melt at 130°C, such as polyethylene, or at 260°C, such as certain nylons (polyamide 6,6), but with design precautions, such as the coating of this core with compounds with a high melting point, such as polytetrafluoroethylene (PTFE), for example.

In order to achieve such mechanical and thermal performances, the choice of the constituent material or the technical core is very important and constitutes a first step. Preferably, this constituent material is produced from a material chosen from the group consisting of para-aramids, meta-aramids, silicone resins, fluorinated resins of polytetrafluoroethylene (PTFE) type, resins comprising glass (or ceramic) as filler, alumina, polyethylene-based resins and a combination of these materials with one another. Other materials still can be employed, such as polyamides, polyesters or polyethylene, for example, provided that these materials have satisfactory properties of resistance to abrasion as defined in the context of the present description.

In a second step, attention is directed at choosing an appropriate structure for the core of the technical yarn, which can be obtained in several ways: firstly by twisting together yarns, for example a para-aramid or glass yarn twisted together with a PTFE or silicone yarn, all of these yarns being made of continuous fibers, secondly by spinning or combing (that is to say, by intimately mixing) these materials in the form of continuous fibers and, thirdly, by coating and/or impregnating (silicone, PTFE, and the like) a core made of para-aramid fiber in particular, or any combination of these alternatives with one another.

This complex yarn (or core) is subsequently either covered with yarn having textile qualities, such as cotton, flax, wool, and the like, (and, in the case of jeans, having been dyed blue beforehand) or impregnated and/or coated with a pasty or liquid mixture (PTFE, silicone, and the like) and with very short and colored textile fibers (cotton, flax, wool, and the like) providing said warp yarn with color and look. This operation can also have the role of forming a UV screen in the case of the use of para-aramid in the core (this

material being highly sensitive to ultraviolet radiation).

According to a first embodiment of the invention, the coating of the technical fiber is carried out by covering with a cotton or wool yarn in helical double coverage.

According to a second alternative embodiment of the invention, the coating of the technical fiber is carried out by coating, with or without impregnating, the technical fiber in a bath of a mixture of fluorinated resin, silicone, acrylate or equivalent polymer resin, which resin is saturated with ultrashort natural fibers. This operation is applied directly to the core yarn or yarns, the objectives being:
- to give slip (necessary for the weaving and the behavior of the "technical yarn/covering yarn" complex in the case of a technical yarn made of glass fiber, for example,
- to reduce the coefficient of friction of the complex,
- to give fire-resistant characteristics (in particular in the case of impregnation of a polyethylene core with silicone or with fluorinated resin),
- to give color, look and certain textile functions, for example in the case of a coating carried out starting from a mixture of fluorinated resin (or silicone or similar products, and the like) saturated with ultrashort and precolored fibers (of cotton, of flax, of wool, and the like). It should be noted that this operation can also be carried out in two stages: impregnation of the yarn and then saturation with fibers at the periphery of the complex. Another alternative is possible; this is the coloring of the bath without addition of fiber.

In order for the invention to be well understood, it will now be described by detailing, as nonlimiting

example, a specific embodiment of an abrasion-resistant fabric according to the invention.

The present invention relates to a monolayer fabric comprising two yarns, a "comfort" yarn of cellulose material and a technical yarn possessing good properties of resistance to abrasion and to temperature. In the description which follows, the comfort yarn made of cellulose material will be described as a cotton yarn, which is the preferred material among the cellulose materials combining in particular cotton, flax, viscose or even acetate.

"Monolayer" fabric is understood to mean that the fabric produced as a single layer makes it possible to provide both comfort, by virtue of the predominant presence on the inside of the weft yarns (comfort of the material and elasticity), and mechanical strength, by virtue of the predominant presence on the outside of the warp yarns (resistance of the material and appearance given by the covering).

These two yarns are woven in a weave defining at least two separate portions in the thickness of the fabric, a first outer portion predominantly of technical yarn and a second inner portion predominantly of comfort yarn, said portions being at least partially entangled.

More specifically, this fabric according to the invention is obtained by weaving, the weft yarn being composed of the comfort yarn and the warp yarn of the technical yarn. More particularly, the weave used is a 3/1 or 2/1 twill.

The weft, which is white in color, as in the case of jeans, is composed of cotton yarns in order to contribute the comfort demanded for the virtually daily use of clothing manufactured with the fabric according to the invention. These cotton yarns are supplemented

with elasthane in order to obtain good elasticity and thus good extensibility of the fabric.

The weft used here is a carded yarn (or combed yarn for greater tensile strength) which has a count of 1/12 Nm +/- 100% (or twist 2/24 Nm for even greater tenacity) and to which elasthane is added (1% to 8% of the finished fabric).

The warp, which is blue in color, as in the case of jeans, is composed of a covered technical yarn. This technical yarn has qualities of resistance to abrasion, qualities of low coefficient of friction and fire-resistant qualities. It is a para-aramid 440 Dtex comprising nontextured continuous filaments (that is to say, a simple core).

According to the invention, the technical yarn is covered over more than 85% of its surface by a coating at least partially comprising natural fibers. More specifically, the coating of the technical core is carried out by covering with a cotton yarn in helical double coverage, which makes possible excellent comfort during summer by virtue of the lightness of the fabric obtained and by virtue of good sweat-absorption ability, while retaining an appearance of 100% cotton fabric.

In this case, the covering is carried out in double coverage (2 yarns surround the core in a helical fashion), so as to obtain a coverage of a minimum of 85% of the surface of the technical yarn (referred to as core). The coverage yarns are very fine, that is to say with a count of less than 1/80 Nm, and are made of cotton or wool natural fibers.

In the specific case described here, the coverage material is a long fiber combed 100% cotton for fabrics which have to be used for summer clothing or a combed

100% wool for fabrics which have to be used for winter clothing.

In the context of the present invention, the covering yarn fulfils the roles of receiving dye particles, of comfort and of hydrophilicity but especially of concealing the technical core around which it is positioned, this core contributing the role of resistance to abrasion.

After weaving, the finishing does not require any particular attention; it is even possible to envisage piece dyeing or conventional surface treatments (printing, delustering coating, and the like).

During a fall from a motorcycle, the term "abrasive impact" is used as the impact damages the fabric and raises its temperature before abrading it via the slide. The Fédération Internationale de Motocyclisme [International Motorcycling Federation] instead uses the term "impact abrasion", which is equivalent.

In the case of a fabric according to the invention, the energy of the impact is partially absorbed by the damage to the coating of the warp yarns.

Subsequently, the warp yarns being exposed, the energy of the slide is warded off by virtue of the low coefficient of friction and of the hardness of the materials constituting the core of said warp yarns (technical yarns). Moreover, the energy is also absorbed in part by virtue of the flexibility of the fabric, which accepts certain deformations. The flexibility in the weft direction is given by the elasticity of the weft yarns and the flexibility in the warp direction, although being lower, is given by the Young's modulus of the core material, which has to be low.

This has the effect of greatly slowing down the appearance of a hole in the fabric.

The fabric (in the case of the colored woven) thus obtained bears a strong resemblance to denim. However, the use of such a fabric offers novel creativity possibilities for designers; worn next to the skin for pants or lined for bomber jackets, in all possible colors, colored woven and piece dyeing, it offers true protection when falling from a motorcycle, for example. Furthermore, it does not melt in the event of fire or of prolonged abrasion and is decomposed neither by UV radiation nor by hydrocarbons.

It is obvious that the invention is not limited to the embodiment described above by way of example but that, on the contrary, it embraces all the alternative forms thereof. Thus, the weaves used for the weaving of the comfort yarn and of the technical yarn can vary, provided that the weave chosen promotes the presence of the technical yarn in the portion of the fabric situated on the outside of the latter and simultaneously promotes the predominant presence of comfort yarn in the portion inside the fabric. Furthermore, this structure allows different weaves according to fashion (half-plait, herringbone pattern, and the like).